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TP 2000 WOOD CHIP BURNER INSTALLATION, BROOKVALE, P.E.I.

PREPARED FOR:

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EXECUTIVE SUMMARY

This report describes the installation and monitoring of a Finnish TP 2000 30-kW wood chip stoker-burner in the home of Wayne Van Toever in Brookvale, P.E.I. over the 1989 January-to-June heating season.

A Finnish TP 2000 wood-chip-fired stoker-burner was installed in a 3,000 square-foot home in Brookvale, P.E.I. in the fall of 1988 and the system was monitored over the winter heating season. The stoker was connected to a Patlyn hot water boiler which functioned as a heat exchanger for the burner. The unit was fueled by hardwood chips with an average moisture content of 25 per cent WB produced by a Danish TP 960 chipper. The burner was also tested on wood chips from three commercial suppliers on P.E.I. The performance of the burner was satisfactory on wood chips less than 40 per cent WB. The homeowner was pleased with the performance of the burner.

RÉSUMÉ

Le présent rapport décrit l'installation et la surveillance du poêle en question d'une capacité de 30 kW, alimenté aux copeaux de bois, dans la maison de Wayne Van Toever à Brookvale, I.-P.-É., durant la saison de chauffage de 1989 (janvier à juin).

Un poêle finlandais de modèle TP 2000 alimenté par copeaux de bois fut installé dans une maison de 3 000 pieds carré située à Brookvale, I.-P.-É., à l'automne 1988 et un suivi effectué tout au long de l'hiver. Le poêle était relié à un réservoir d'eau chaude qui servait d'échangeur de chaleur. Il était alimenté par des copeaux de bois dur produit à l'aide d'une déchiqueteuse et ne contenant pas plus de 25 % d'humidité. On a aussi utilisé, à titre expérimental, des copeaux en provenance de trois différents fournisseurs commerciaux de l'Ile. Dans le cas des copeaux contenant 40 % d'humidité et moins, la performance du poêle s'est avérée satisfaisante. Le propriétaire s'est dit content du rendement du poêle.

INTRODUCTION

The TP 2000 is a woodchip stoker developed in Pori, Finland in the 1980s. Information in the bioenergy field and tests in 1987-88 at IRTA in Clarence Creek, Ontario in 1986 and 1987 indicated that it was one of the most cost effective woodchip burners for the heating of private residences and small businesses on the market today. In order to get more long term field operating data, Bruce McCallum was contracted by the Renewable Energy Division of EMR Canada in October 1988 to install, test and monitor a 30 Kw TP 2000 stoker in home of Wayne Van Toever in Brookvale, PEI. over the 1988-89 heating season.

Mr. Van Toever has a large 3,000 square foot home that includes an apartment for his father. The house was previously heated with roundwood. The house is adjacent to his fish hatchery which is heated by a 200 Kw Saturn woodchip burner. He produces his own woodchips with a TP 960 tractor powered chipper from wood from his own woodlot and purchased low grade pulp wood.

INSTALLATION

WOODCHIP BURNER

The TP 2000 burner is designed and built in Pori, Finland by a designer and manufacturer called Topi Pamppi. It has a .43 cubic metre fuel bin with a gasketed lid. A 10 cm diameter screw turns a fuel agitator in the bin and augers woodchips into a firetube combustion chamber. A fan supplies combustion air through a series of holes mainly in the bottom of firetube. The feed rate of the screw-auger can be varied by adjusting the offset ratchet which drives the auger.

When the thermostat in the home calls for heat, the circulation pumps operate and the temperature in the boiler drops. The boiler aquastat will then call for heat from the chip burner. The chip burner then goes into the "highfire" mode. In the highfire mode the fan and the auger run continuously and the burner puts out its rated output of about 30 Kw. When the temperature in the boiler rises above a set point the boiler aquastat ceases to call for heat and the chip burner reverts to the "holdfire" mode. In holdfire the fan and the feed screw run briefly at set intervals to keep just enough fuel in the firetube to maintain a fire.

A Danfos dowser or anti-burnback sprinkler was installed on the feed tube to guard against a fire moving back up the feed tube and into the fuel bin. The dowser has a heat sensitive proportional valve which admits more water into the feed tube the higher the temperature on the mercury bulb and less water as the fire is extinguished and the temperature recedes.

The dowser was activated once in June of 1989, flooding the fuel bin and the boiler. It is not known what caused the burnback. It is possible that an ash clinker was allowed to build up in the firetube, resulting in backpressure which drove the fire back up the feed tube towards the fuel bin. It is known that the chip burner was running only on holdfire for more extended periods because there was little demand for heat or domestic hot water.

HEAT EXCHANGER

The heat exchanger is an 80,000 BTU/HR. Patlyn roundwood boiler, built in Charlottetown by Corrigan's Welding and Woodstoves Ltd. This is a popular roundwood boiler in PEI. Unfortunately, it did not prove to be a suitable heat exchanger for the TP 2000 chip burner. Unlike a roundwood fire the chip burner fire has only a small radiating surface area. The smoke path in the boiler is very short and the gases from the burner passed quickly up the smokepipe. Smokepipe temperatures of 350° F were recorded. A piece of sheet metal was jammed into the firetube to direct the chip burner gases below the boiler water shelf. This marginally improved the heat exchange capacity of the boiler.

FUEL HANDLING

Fuel was transported to the fuel storage room in plastic boxes in station wagon or pickup from the main fuel reserve in the hatchery.

NORMAL MODE OF OPERATION

The normal operating procedure developed by Mr. Van Toever was to check the machine in the morning and remove the ash build-up in the firetube with a small poker. This ash will build up into a crusty clinker covering about half of the feed tube if it is not removed daily. In the evening he filled the fuel hopper. A full bin of woodchips heated his large home for 24 hours.

In his experience the fuel consumption did not vary significantly between very cold and relatively mild days. This may be because the chip burner still burns quite a bit of fuel in the holdfire mode, even though the actual heat requirement is much less during mild days. On highfire combustion efficiency is much higher.

Wayne Van Toever travels frequently for business purposes. On several occasions the chip burner went out, either because the fuel bin had not been filled or or because of power failures longer than 30 minutes. Carol Van Toever experienced some difficulty in relighting the burner. One has to remove most of the woodchips from the firetube, place lighted paper in the tube with a few woodchips on top and turn the burner switch on in order to activate the combustion air fan and achieve ignition of the woodchips. Unfortunately, the burner switch also simultaneously activates the feed auger motor and the advancing woodchips can push the paper and igniting woodchips out of the firetube before proper ignition occurs.

On other occasions the fuel reserve could not be replenished because of severe snow storms. The result of these difficulties was that the Van Toevers developed a pattern of operation in which he operated the chip burner when he was home. When he went out of town Carol Van Toever would let the burner run out of chips and go out and then shut off the burner. The oil boiler was set up to pick up the heat load automatically if the boiler temperature dropped below a certain point. This pattern of operation was regrettable from the point of view of the monitoring of the operation of the chip burner.

PERFORMANCE ON VARIOUS WOODCHIPS

The burner has been run mainly on Mr. Van Toever's own woodchips which he uses for the woodchip burner in the fish hatchery. He chipped his own delimbed hardwood with his Danish TP 960 chipper. (There is no connection between the Danish TP chipper manufacturer and Finnish TP 2000 burner manufacturer). The woodchips were very small or fine and they were 2 years old. The moisture content on a wet basis (WB) was 25%. These woodchips fed and burned very well in the TP 2000 burner. They were probably an ideal fuel for this burner.

Under the terms of the test and monitoring contract between the author and Energy, Mines and Resources Canada the burner was to be tested on three different woodchip fuels available from PEI commercial fuel suppliers. Ten feed bags of commercial woodchips were obtained from each of the following suppliers:

1. Co-op Forestiere, Abram Village- These were woodchips produced by a tractor-powered Bruks chipper from low-grade pulpwood for use in the Co-op s own KMW plant at the Evangeline school. The moisture content was 32% WB. These woodchips burned without any problems in the TP 2000 burner.

2. PEI Energy Corporation, Charlottetown-These whole-tree woodchips came from the outdoor pile in Charlottetown owned by the Corporation. They were produced by the Bruks 800CT chipper owned by Bulk Carriers Ltd. during the summer of 1988. The moisture content was 35% WB. These woodchips burned without any problems in the TP 2000 burner.

3. Larsen's Sawmill, Rose Valley- These were screened chips produced from sawmill slabs. The moisture content was 45%. Not surprisingly, these wet woodchips failed to burn in the TP 2000. Bridging occurred in the hopper and the burner repeatedly went out, despite attempts to adjust the air and feed rate. Clearly these woodchips were too wet for this burner.The fact that these wet chips were stored in a cold fuel reserve made them more sticky and exacerbated bridging. However, when Larsen's chips were mixed by alternating one bag of them with one tray of Mr. Van Toever's chips no further problems were experienced in burning them.

RECOMMENDATIONS:

IMPROVED OPERATING PROCEDURES

The difficulties experienced in relighting the chip burner can be eased by keeping a quantity of very dry chips or shavings on hand for that purpose. The fuel chips can be removed and replaced by a small amount of the dryer lighting fuel.

Daily de-ashing is clearly important and this should be made clear to the operator with a sign on the burner that stresses that de-ashing must be done daily without fail.

DESIGN CHANGES

The TP 2000 is a very good residential and small commercial woodchip burner, but a number of relatively minor changes would greatly enhance its safety and general performance. These include:

1.The problems of in re-lighting the burner would be greatly eased by the installation of a separate shutoff switch on the feed auger motor. This would allow the combustion air fan to run without the auger feeding in more chips during the startup period.

2.The dowser should be made a standard feature. There is always the danger of a burnback.

3.There should be an alarm or a shutoff switch activated by a failure to close the fuel bin lid. An alarm would alert the operator that the lid has been left open. Alternatively, a shutoff switch with a manual re-start, activated by opening the lid, would make the operator very sensitive to making sure that the lid was properly closed. A burnback is very unlikely as long as the lid has been properly closed and the firetube de-ashed.

4.The TP 2000 does not have a device to detect the loss of fire in the firetube. In this case the boiler temperature drops and the aquastat signals to the chip burner to go into highfire. The feed auger runs continuously spilling woodchips into the boiler, theoretically until the fuel bin is empty. This can be dangerous if the burner and boiler should be pushed apart by the force of the feed auger pushing woodchips into the boiler and fuel spilled out in the boiler room. A smouldering coal, exposed to the air, could cause a major fire.

The simplest way to solve this problem is to install a separate or multi-function aquastat that would shut the burner down completely if the boiler temperature dropped below a set point, as it would if the fire went out.

5.It has been well established that the TP 2000, and most holdfire woodchip burners burn very cleanly on highfire and are somewhat dirty in the holdfire mode. The reasons for this are that combustion chamber cools

during holdfire and the fire is starved for air because the combustion air fan shuts down. The easiest way to reduce high holdfire emissions is to install a variable speed fan and modify the control panel such that the fan can be adjusted to run at the minimum speed necessary to achieve clean combustion in the holdfire mode.

These various recommended changes would add to the cost of the burner, but they would greatly enhance its performance and safety.

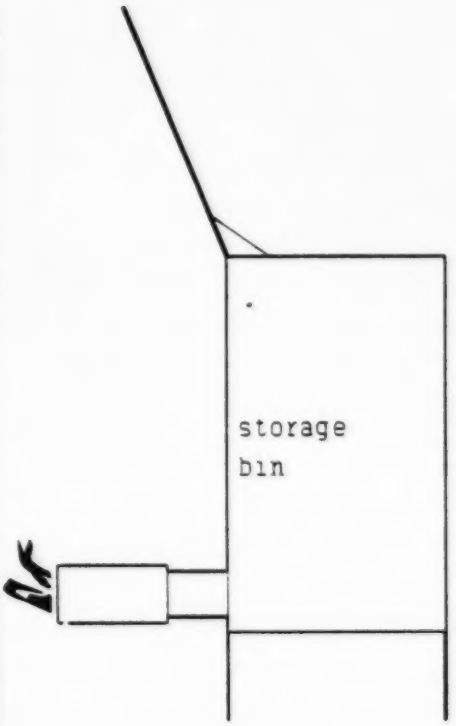
THE NEED FOR A SUITABLE HEAT EXCHANGER

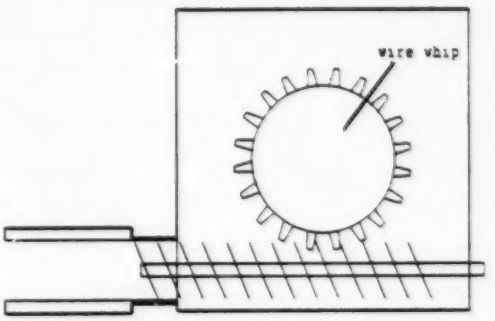
As stated above, the Patlyn boiler proved to be unsuitable for the TP 2000 and probably most other woodchip or sawdust burners. The original Kerr Titan vertical tube boiler, built by Parsborro Metal Fabricators in Nova Scotia, worked well with the Saturn woodchip and sawdust burners in the early 1980s. Vertical tube boilers are much less subject to tube fouling than horizontal tube boilers. The vertical tube Kerr Titan would likely work well with the TP 2000 chip burner. It would be worthwhile to test the TP 2000 in combination with the vertical tube Titan boiler. This boiler is no longer in production, but Parsborro Metal Fabricators have indicated that they would be willing to produce it again if they received a minimum quantity order.

COMMERCIALIZATION

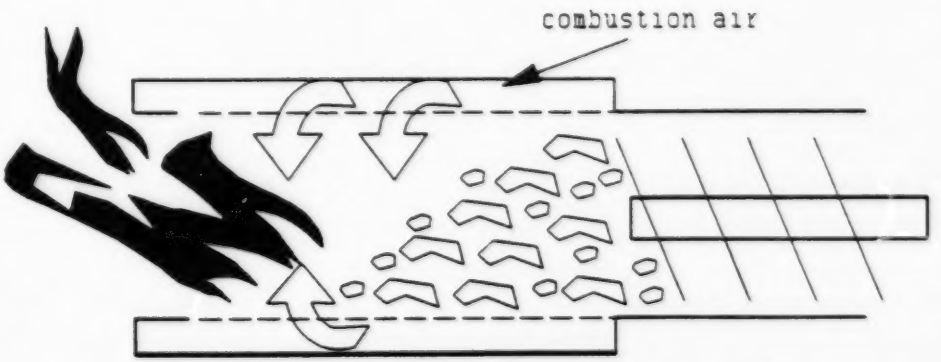
The TP 2000 is a simple, well designed woodchip burner. With the incorporation of the minor design changes suggested above it would be suitable for CSA testing and commercialization by a licensed Canadian manufacturer. In order to make this economically practical it would have to be produced in sufficient quantities to achieve economies of scale and make the burner available at a reasonable cost. Energy, Mines and Resources Canada should give some consideration to providing financial support for a multi unit demonstration project. This project could be similar to the PEI Saturn woodchip burner project that the Department sponsored in the early 1980s in concert with the Institute of Man and Resources. That project was relatively successful. Most of the Saturn chip burners are still in operation on either woodchips or sawdust. Unfortunately, the Saturn burner was not suitable for CSA approval and commercialization and the manufacturer ceased production. The TP 2000 is a much superior burner that is ready for full commercialization in Canada if the market place could be stimulated by a demonstration project.

TP2000 30kW Stoker





Bin Bottom with Auger



Combustion Tube

Tehokasta tekniikkaa pannuhuoneeseen

TP 2000 poltin

- Laita TP 2000 poltin kattilaasi — kotimaisen polttoaineen helpoin käyttötapa.
- Ei savuhaittoja.
- Polttoaineena hienohake, palaturvemurske tai pelletti.
- Poltin on automaattinen ja varmatoiminen.
- Erittäin korkea hyötysuhde takaa vähäisen polttoaineen kulutuksen.

Kolme kokoa:
- 180/10 kW
- 360/17 kW
- 500/25 kW

- Poltin voidaan asentaa useimpiin eri kattilatyyppeihin.

MYYJÄ:

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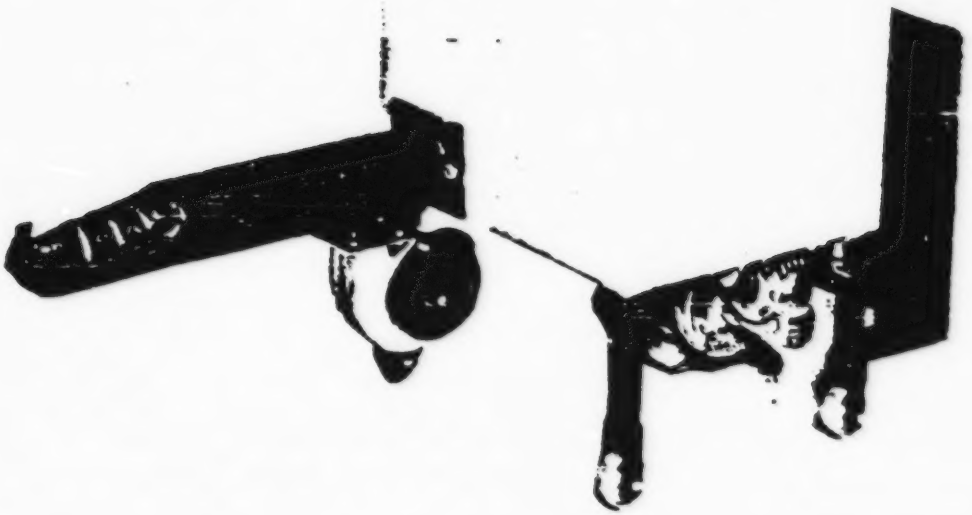
TP 2000 STOKER

F O R

B I O F U E L C O M B U S T I O N



FOR WOODCHIPS AND VARIOUS FUEL PELLETS.

Capacities: 30 000, 60 000, 90 000 & 150 000 BTU